

IN THE CLAIMS:

1. (previously presented) A method for recovering phase information comprising:
over-sampling data transmitted at a first frequency using a clock at a second frequency to obtain groups of n samples, where n is an integer greater than one;
storing a plurality of m of said groups of n samples, where m is an integer greater than one;
outputting said plurality of m of said groups of n samples simultaneously at a clock frequency which is said second frequency divided by m .
2. (original) A method according to claim 1 and further including:
using said plurality of m of said groups of n samples to detect transitions in said data; and
maintaining an historical record of said transitions.
3. (original) A method according to claim 2 and further including:
using said historical record to determine a phase of said second frequency that is nearly centered in the middle of a bit time of said data at said first frequency.
4. (original) A method according to claim 3 wherein said step of determining a phase comprises:
 - a. Oring each history bit with the following bit to obtain a highest byte;
 - b. Oring each bit in said highest byte with a bit on either side to obtain a second highest byte;
 - c. Oring each bit in said second highest byte with a bit on either side to obtain a third highest byte; and
 - d. determining the highest level byte which has two or fewer zeros and outputting:
 - i. the phase of the sole remaining zero if there is only one zero;
 - ii. the phase of the latest zero if an adjacent pair remains;
 - iii. an error indication if two non-adjacent zeros remain.

5. (original) A method according to claim 4 and further including limiting the maximum phase change to plus or minus one sample phase.
6. (original) A method according to claim 3 and further including:
using said historical record to select bits of said data at said first frequency and output said bits in groups of generally m valid bits at a time at said second frequency divided by m.
7. (original) A method according to claim 6 wherein, due to the difference in said first and second frequency a draft occurs causing said phase to select m+1 or m-1 bits of data and further including:
outputting either m, m+1 or m-1 valid bits; and
using said historical record to provide an indication of how many bits are being output.
8. (original) A method according to claim 7 wherein said step of providing an indication of how many valid bits are being output comprises:
 - a. determining whether the current phase selection is different from the previous phase selection and if not, indicating that bits m:1 are valid;
 - b. if the current phase selection is different from the previous phase selection, determining if the current phase selection wraps around from the previous phase selection and if not, indicating that bits m:1 are valid;
 - c. if the current phase selection wraps around from the previous phase selection determining if it wraps around from the latest to earliest sample phase, and, if so, indicating that bits (m-1):1 are valid; and
 - d. if the current phase selection wraps around from the previous phase selection determining if it wraps around from the earliest to latest sample phase, and, if so, indicating that bits m:0 are valid.

9. (previously presented) A method for recovering phase information comprising:
- over-sampling data transmitted at a first frequency using a clock at a second frequency, n times per bit time to obtain n samples, where n is an integer greater than one;
 - using said n samples to detect the transitions between two logic levels in said transmitted data and provide n edge results which are at one logic level to indicate a transition and the other logic level to indicate no transition;
 - storing, in sequence, at said second clock frequency, m sets of said n samples, where m is an integer greater than one; and
 - outputting said m times n samples at a clock frequency which is said second frequency divided by m .
10. (original) A method according to claim 9 and further including maintaining a running history of said edge results comprising:
- combining in n separate m input OR gates the m times n samples, each gate having as inputs the m of said samples in the same relative position in each of said m sets;
 - using the outputs of said n OR gates to set p sets of byte registers, each having n registers; and
 - resetting said p byte registers in a wrap around sequence.
11. (original) A method according to claim 10 and further including:
- using outputs of said byte registers to determine a phase of said second frequency that is nearly centered in the middle of a bit time of said data at said first frequency.
12. (original) A method according to claim 11 wherein said step of determining a phase comprises:
- a. Oring each history bit with the following bit to obtain a highest byte;
 - b. Oring each bit in said highest byte with a bit on either side to obtain a second highest byte;

- c. Oring each bit in said second highest byte with a bit on either side to obtain a third highest byte; and
 - d. determining the highest level byte which has two or fewer zeros and outputting:
 - i. the phase of the sole remaining zero if there is only one zero;
 - ii. the phase of the latest zero if an adjacent pair remains;
 - iii. an error indication if two non-adjacent zeros remain.
13. (original) A method according to claim 12 and further including limiting the maximum phase change to plus or minus one sample phase.
14. (original) A method according to claim 13 and further including:
using said phase to select bits of said data at said first frequency and output said bits in groups of generally m at a time at said second frequency divided by m.
15. (original) A method according to claim 14 wherein, due to the difference in said first and second frequency a drift occurs causing said phase to select m+1 or m-1 bits of data and further including:
outputting either m, m+1 or m-1 bits; and
using said phase information to provide an indication of how many bits are being output.
16. (original) A method according to claim 15 wherein said step of providing an indication of how many bits are being output comprises:
 - a. determining whether the current phase selection is different from the previous phase selection and if not, indicating that bits m:1 are valid;
 - b. if the current phase selection is different from the previous phase selection, determining if the current phase selection wraps around from the previous phase selection and if not, indicating that bits m:1 are valid;

- c. if the current phase selection wraps around from the previous phase selection determining if it wraps around from the latest to earliest sample phase, and, if so, indicating that bits $m-1:1$ are valid; and
- d. if the current phase selection wraps around from the previous phase selection determining if it wraps around from the earliest to latest sample phase, and, if so, indicating that bits $m:0$ are valid.

17. (previously presented) Apparatus for recovering phase information comprising:
an over-sampler having an input for data transmitted at a first frequency and n sampling clock inputs each at a second frequency but different phase each clock shifted in phase from an adjacent clock by $360/n$ degrees and providing n sample outputs, where n is an integer greater than 1; and

a sample word register having inputs coupled to said n sample outputs, storing m sets of said n sample outputs at said second frequency and outputting said m sets of n sample outputs at a frequency equal to said frequency divided by m , where n is an integer greater than 1.

18. (original) Apparatus according to claim 18 and further including an edge detector using said m sets of n sample outputs to detect the transitions between two logic levels in said transmitted data and provide m sets of n edge results which are at one logic level to indicate a transition and another logic level to indicate no transition.

19. (original) Apparatus according to claim 18 wherein said edge detectors comprise a plurality of XOR gates.

20. (original) Apparatus according to claim 19 and further including:
separate m input OR gates, each gate having as inputs the m of said n edge results in the same relative position in each of said m sets of n edge results; and
 p sets of n -bit byte registers, the outputs of each of said n OR gates being a set input to one of the n bits in each of said p byte registers.

21. (original) Apparatus according to claim 20 and further including a packet state machine providing reset inputs to said byte registers.
22. (original) Apparatus according to claim 21 and further including:
phase selection logic having the outputs of said byte registers as inputs and outputting a signal indicating a phase of said second frequency that is nearly centered in the middle of a bit time of said data at said first frequency.
23. (original) Apparatus according to claim 22 and further including:
a data selector register having a data input from said sample register and the output of said phase selection logic as a select input to select bits of said data at said first frequency and output said bits in groups of generally m valid bits at a time at said second frequency divided by m .
24. (original) Apparatus according to claim 23 wherein due to the difference in said first and second frequency a drift occurs causing said data selector register to output $m+1$ or $m-1$ valid bits of data and further including:
a bit count state machine providing as an output an indication of how many valid bits are being output by said data selector register.